STATUS OF PENDING CLAIMS AFTER INCORPORATION OF AMENDMENTS

Claims 1, 21, 23 – 31, and 43 – 54 are now pending in the application. The claims now comprise five (5) independent claims, nine (18) dependent claims and fourteen (23) total claims. As fees have previously been paid for twenty-three (23) total claims and five (5) independent claims, it is asserted that no fees are due for excess claims in this response. Claims 22 and 32 – 42 are cancelled herein.

REMARKS ON THE OUTSTANDING OFFICE ACTION

SUMMARY OF OFFICE ACTION OF DECEMBER 5, 2001

Claims 1 and 21 – 42 were pending before the office immediately prior to the office action dated December 5, 2001 (the "Office Action"). Claims 21, 30 and 31 were object to in the Office Action because of informality. Claims 32 – 42 (erroneously indicated on the Office Action Summary as claims 21 – 25)) were withdrawn from consideration by the Examiner. Claims 1, 21 – 23 and 26 – 31 were rejected under 35 U.S.C. §103.

RESPONSE TO ELECTION/RESTRICTION

The Examiner has withdrawn form consideration claims 32 – 42. The Examiner asserts that the applicant constructively elected by original prosecution on the merits and independent or distinct invention from that claimed in claims 32 – 42. Claims 32 – 42 are asserted to be drawn to an apparatus rather than a process as in the constructively elected invention.

Applicants respectfully traverse such restriction requirement asserting that claims 32 – 42 do not pose a further on the burden on the Examiner with regard to searching, and that these claims should be considered in conjunction with the others. Applicants, however, provisionally cancel such claims in the present response in order to streamline prosecution in this case. Applicant respectfully asks that the Examiner to reconsider the restriction requirement.

RESPONSE TO OBJECTIONS

In the Claims:

The Examiner has objected to claims 21, 30 and 31 due to claimed temperatures lacking the degree symbol (Page 2, Paragraph 4 of the Office Action). As each of these claims has been amended herein to include such a symbol, Applicants respectfully assert that such objections are obviated.

RESPONSE TO REJECTIONS

In the Claims:

- Claim Rejections under 35 U.S.C. § 103(a):
  - The Examiner's Position:

The Examiner has rejected claims 1, 21 – 23, 24, 25, and 26 – 31 under 35 U.S.C. § 103(a) as being unpatentable over the translation of German Patent No. 1,049,851 in view of *Conventional Thermal Cracking*, Knight and Peniston-Bird, in Modern Petroleum Technology, 4th Edition (John Wiley & Sons 1973) at pages 280 – 281 ("Modern Petroleum Technology article"), and U.S. Patent No. 4,426,278 to Kosters ("U.S. Patent No. 4,426,278 to Kosters").

The Examiner further has rejected claims 24 and 25 under this provision in light of the same references in view of U.S. Patent No. 1,811,195 to Watson ("U.S. Patent No. 1,811,195 to Watson").

The Examiner characterizes German Patent No. 1,049,851 as disclosing "a hydrocarbon cracking process which involves the heating of a hydrocarbon and the addition of a heat transfer gas to the feed which is passed to a reactor" (page 3, paragraph 5 of the Office Action). The Examiner asserts that the "disclosure of cracking" in German Patent No. 1,049,851 "encompasses applicant's splitting limitations, " that the reference's "heat transfer gas is considered to correspond to applicant's jet containing energy," and that the "reference's

disclosure of a high boiling point crude fraction meets applicant's heavy distillate limitation" (page 3, paragraph 5 – page 4, paragraph 1 of the Office Action).

The Examiner acknowledges several differences between German Patent No. 1,049,851 and the embodiments set forth in the claims pending as of the date of the Office Action: (1) "that the reference is silent about the jet mechanically shearing the molecules of the load to produce liquid hydrocarbons" (page 4, paragraph 1 of the Office Action); (2) the reference "is silent about a reactor temperature of less than about 520°C and about a first temperature (preheating) that is about 20°C less than the second temperature (page 4, paragraph 3 of the Office Action); (3) the reference "is silent about the velocity of the jet injected through the nozzle" (page 4, paragraph 3 of the Office Action); (4) the reference "is silent about an additional soaking step" (page 4, paragraph 3 of the Office Action); and (5) the reference is "silent about the use of steam as a heat transfer gas" even in light of the Modern Petroleum Technology article and U.S. Patent No. 4,426,678 to Kosters (page 6, paragraph 3 of the Office Action). The Examiner, however, asserts that each of these differences is obvious in light of either German Patent No. 1,049,851 itself, the Modern Petroleum Technology article, U.S Patent No. 4,426,278 to Kosters, or U.S. Patent No. 1,811,195 to Watson.

The Examiner maintains with respect to each noted difference: (1) "it would have been obvious to one of ordinary skill in the art at the time of the invention" that the "high speed introduction through the nozzle inlet of German Patent (1,049,851)" would accomplish the same mechanical shearing as claimed (page 4, paragraph 2 of the Office Action); (2) that the Modern Petroleum Technology article teaches "that conventional thermal cracking of crude is accomplished at 455 – 540°C," that a "conventional process involves 'preheating" (page 4, paragraph 4) and that U.S. Patent No. 4,426,278 to Kosters indicates that "preheating temperatures are selected to be low enough to prevent significant cracking reactions" (page 5, paragraph 4 of the Office Action); (3) "any jet velocity that would add sufficient mechanical energy in the process of German Patent (1,049,851)" could be selected by one of ordinary skill in the art as "the reference does not limit the speed of injecting so long as mechanical energy is imparted" (page 5, paragraph 5 of the Office Action); (4) that "conventional thermal cracking processes include soaking steps to complete cracking" (page 4, paragraph 4 – page 5, paragraph

1 of the Office Action) and any additional soaking step to be obvious in light of the Modern Petroleum Technology article and German Patent 1,049,851 as the German Patent is asserted to suggest further cracking of the feed, and the Modern Petroleum Technology article is said to "illustrate[ ] that a soaking step is known to complete cracking reactions" (page 6, paragraph 1 of the Office Action); and (5) in regard to the failure of the German Patent 1,049,851, the Modern Petroleum Technology article or U.S. Patent No. 4,426,278 to Kosters to teach the use of steam of a heat transfer gas, the Examiner asserts that any deficit is overcome by U.S. Patent No. 1,811,195 which is "cited to illustrate that steam is a known heat transfer gas for use in thermal cracking" (page 6, paragraph 4 of the Office Action). The Examiner asserts that it "would have been obvious to one of ordinary skill in the art at the time the invention was made to select steam as the gas injected into the feed because the reference of Watson (1,811,195) illustrates that steam is known to accomplish cracking with the formation of lighter components" (page 6, paragraph 5 of the Office Action).

- Applicants' Position:

Applicants respectfully traverse the Examiner's 35 U.S.C. § 103(a) rejections based in part on the failure of the Examiner to recite adequate motivation for combining the references in the manner indicated, and in part on the basis that the Examiner is using "hindsight reasoning" in an attempt to "approximate" the present invention.

As claims 22, and 32 – 42 are cancelled herein, without prejudice and disclaimer, Applicants assert that rejection with respect to these claims is mooted. Applicants note that each of claims 1, 21 – 32 pending in the application after incorporation of the amendments made herein differ, in certain regards, from the claims that were pending before the Examiner at the time of the December 5, 2001 Office Action. Comments with respect to the rejections, therefore, will be directed below to the amended claims.

Applicants respectfully note that each of German Patent No. 1,049,851, the Modern Petroleum Technology article, U.S. Patent No. 4,426,278 to Kosters, and U.S. Patent No. 1,811,195 to Watson, disclose the cracking of hydrocarbons using strictly thermal means. The Modern Petroleum Technology article references "thermal cracking" to "produce motor

gasoline" (page 280, paragraph 3). U.S. Patent No. 1,811,195 discloses exposing heated vaporous oil to "steam or steam and air superheated to a temperature above the oil vapor, whereby the temperature of the oil, by the process of heat interchange thus provided, is raised sufficiently to effect the cracking thereof" (emphasis added) (col. 1, lines 16 – 26). U.S. Patent No. 4,426,278 discloses directing through a passageway "[h]eating gases at extremely high temperatures ... co-current[ ] with the hydrocarbon-steam mixture, to produce a desirable heat flux for the cracking reaction" (emphasis added) (abstract). German Patent No. 1,049,851 discloses the thermal conversion of liquid hydrocarbons to gaseous hydrocarbons by contact with a hot vapor or gaseous heat transfer medium (col. 1, lines 1 – 9). None of the references indicate that the thermal interchange into the hydrocarbon load to be cracked is not sufficient in itself to crack the hydrocarbons.

With respect to the embodiments of the invention presently asserted, the claims make clear that the mechanical energy applied to the load is needed under the process conditions described to cause shearing of the molecules in the hydrocarbon load, and is not superfluous. Such claims therefore are believed patentably distinct over the references of record. None of the references imply or suggest that the addition of mechanical energy into the load be used to effectuate the shearing of the molecules therein. This is particular true with respect to hydrocarbon loads containing residues or heavy distillates. For example, the Modern Petroleum Technology article actually suggests the rejection of "heavy residual tars" (page 280, paragraph 4).

The embodiments presently claimed provide processes that permit controlled input of energy to break hydrocarbon bonds using relatively moderate temperatures, and may be used without the need for a catalyst. As indicated in the claims, certain such processes may be used to convert hydrocarbon loads containing residues or heavy distillates into lighter liquid products without the generation of significant amounts of coke soot or gas, as would be expected in conventional thermal cracking.

The mechanical breakdown of the molecules is hypothesized to be related to "the interatomic cohesive forces of the component molecules and the to the fact that the matter ...

exceeds the acceptable maximum deformation" (page 47, lines 20 – 23). Mechanical energy may be provided to the load by means of a jet of gases or vapors which act as energy vectors to the load (See, page 7, line 14 of the Specification). As indicated in the Specification (page 8, lines 24 – 25) the energy supply to a load is "determined by the temperature, flow rate and the expansion rate [of the gases] in the injector." As the amount of mechanical energy applied to a load may be carefully controlled, it is possible to "release[ ] a usable quantity of mechanical energy that provides for the supply of the energy that is necessary and barely sufficient to initiate the reactions without tearing the peripheral hydrogen of the molecules and without creating an energy such that the molecule may be broken into very small fragments, as may occur in a FCC" (Page 8, lines 20 – 28 of the Specification). The control of the "breakdown of molecules makes it possible to avoid producing gases by never implementing the energy required for their formation" (page 10, lines 6- 7 of the Specification).

Control of mechanical energy input into the load may be effected through an injector that may be used to create close contact between the load and the injected gases or vapors, and may provide for transfer of energy that contributes to the activation of the reactions (See, page 44 , line 21 – page 45, line 13). The injector may reduce rejoining of broken fragments by "insert[ing] gaseous molecules during the expansion between the fragments formed" (page 48, lines 15 – 17). Adiabatic relief of the gases or vapors coursing through the injector may be used to add mechanical energy as kinetic energy to the load (See, page 50, lines 6 – 12 of the Specification).

In short, it respectfully asserted that none of the references, alone or in combination, teach, suggest or imply all of the limitations of the embodiments asserted in the present claims. For example, the references fail to teach, suggest or imply the conversion of hydrocarbons suing mechanical shearing, the generation of substantially no soot or coke in the shearing process, the production of a very stable hydrocarbon-water emulsion, a process wherein substantially all of the hydrocarbon molecules are broken in two, a non-catalytic method for breaking hydrocarbons without excessive transfer of heat, etc.

CONCLUSIONS

In view of the above, it is respectfully submitted that the subject matter of the pending claims is patentable over the references of record. An early notice of allowance is therefore earnestly requested.

FEES DUE

It is believed that no fee is due. However, the Commissioner is hereby authorized to charge any fees that may be required, or credit any overpayment, to Deposit Account 033-975.

Respectfully Submitted,

Date: August 21, 2002

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SCHEDULE A

In the Claims:

MARKED CLAIMS AS PENDING AFTER INCORPORATION OF AMENDMENTS, CANCELLATIONS, AND ADDITIONS MADE HEREIN

1. **(Twice Amended)** A non-catalytic process for the conversion of a hydrocarbon load ~~hydrocarbons~~ containing residues or heavy distillates ~~which may be laden with impurities~~ into lighter liquid products that may be distilled, the process comprising the steps of:

preheating ~~a~~ said hydrocarbon load to a first temperature, wherein the load comprises one or more hydrocarbons selected from the group consisting of residues and heavy distillates;

injecting ~~the~~ said hydrocarbon load into a reactor, wherein the reactor is operated at a second temperature, wherein the second temperature is less than about 520 °C and about 20°C - 25°C greater than the first temperature, and wherein the temperature of the reactor in conjunction with the conditions within the reactor is insufficient to thermally crack the load;

mechanically shearing the molecules of the load with a jet to produce hydrocarbons comprising liquid hydrocarbons, said jet having a temperature insufficient to thermally crack said hydrocarbon load and operatively associated with said load so as to input mechanical energy into said load., ~~substantially no gaseous hydrocarbons, and substantially no coke or soot~~

21. **(Once Amended)** A process for the conversion of ~~hydrocarbons~~ a hydrocarbon load containing residues or heavy distillates comprising hydrocarbon molecules ~~which may be~~

~~laden with impurities~~ into lighter liquid products that are substantially free of soot, coke and gases, the process comprising:

preheating a hydrocarbon load to a temperature that is below a temperature necessary to thermally crack the hydrocarbon load under the conditions such hydrocarbon load is subjected;

~~injecting the load into a reactor, wherein the reactor is operated at a second temperature which is less than a cracking temperature of the load;~~

~~passing~~ intimately contacting the load ~~through~~ with a high-speed jet having a temperature that is insufficient under the conditions of the contact to thermally crack said hydrocarbon molecules in said load~~, wherein the~~ said high-speed jet having a speed ~~of the jet~~ and expansion rate that ~~is sufficient to~~ imparts ~~enough~~ sufficient mechanical energy to the hydrocarbon molecules of the hydrocarbon load to cause the molecules to split ~~wherein substantially all of the split molecules comprise liquid hydrocarbons.~~;

injecting the hydrocarbon load into a reactor, wherein ~~the~~ said reactor is operated at a second temperature which is less than a cracking temperature of the load under the conditions within said reactor;

obtaining liquid hydrocarbons from said reactor.

22. **(Cancelled)**

23. **(Once Amended)** The process of claim ~~22~~23, further comprising saturating the ~~sheared~~ split molecules of the load in a soaking chamber.

24. **(Once Amended)** The process of claim ~~23~~ 24, wherein saturating the ~~sheared~~ split

molecules of the load comprises utilizing steam for the jet, wherein the sheared molecules of the load are allowed to soak in the steam.

25. **(Once Amended)** The process of claim ~~22~~ 23, wherein the jet comprises steam.

26. **(Once Amended)** The process of claim ~~22~~ 23, wherein the jet has a velocity of about 700 m/s.

27. **(Once Amended)** The process of claim ~~22~~ 23, wherein the jet is preheated to a temperature at which no substantial thermal conversion of the load occurs.

28. **(Once Amended)** The process of claim ~~22~~ 23, wherein the load is not vaporized prior to introduction into the path of the jet.

29. **(Once Amended)** The process of claim ~~22~~ 23, wherein the load is introduced into the path of the jet in ~~a~~ said reactor~~, wherein the reactor is maintained at a temperature at which no substantial thermal conversion of the load occurs~~.

30. **(Once Amended)** The process of claim ~~29~~ 23, wherein the temperature of the reactor is about 540°~~degrees~~ C.

31. **(Once Amended)** The process of claim ~~29~~ 23, wherein the temperature of the jet is about 25° ~~degrees~~ C greater than the temperature of the reactor.

32. **(Cancelled)**

33. **(Cancelled)**

34. **(Cancelled)**

35. **(Cancelled)**

36. **(Cancelled)**

37. **(Cancelled)**

38. **(Cancelled)**

39. **(Cancelled)**

40. **(Cancelled)**

41. **(Cancelled)**

42. **(Cancelled)**

43. **(New)** A process for converting a hydrocarbon load comprising a plurality of hydrocarbon molecules, the process comprising the steps of:

(a) heating said hydrocarbon load to a temperature that fails to provide enough thermal energy to crack said hydrocarbon molecules in said hydrocarbon load;

(b) inputting mechanical energy into said heated hydrocarbon load sufficient to cause shearing of said hydrocarbon molecules in said hydrocarbon load.

44. **(New)** A process for converting a hydrocarbon load comprising a plurality of hydrocarbon molecules, said hydrocarbon load requiring a enthalpy variation value of E for cracking of the hydrocarbon molecules contained in the hydrocarbon load, the process comprising the steps of:

(a) heating said hydrocarbon load to a temperature producing a enthalpy variation of E – X, wherein X is not zero or negative;

(b) adiabatically inputting mechanical energy into the heated hydrocarbon load to produce an enthalpy variation value of ≥ X to obtain shearing of said hydrocarbon molecules in said hydrocarbon load.

45. **(New)** A process for the conversion, without the use of a catalyst, of a hydrocarbon load containing residue and heavy distillates comprising hydrocarbon molecules into lighter liquid products that may be distilled, the process comprising the steps of:

(a) preheating said hydrocarbon load to a first temperature that is below a temperature necessary to thermally crack the hydrocarbon load under the conditions such hydrocarbon load is subjected;

(b) injecting into said preheated hydrocarbon load a jet of heated gas or steam to form a load/jet mixture, said load/jet mixture being at a temperature that in itself is insufficient to thermally crack the hydrocarbon load under the conditions such hydrocarbon load is subjected;

(c) injecting the load/jet mixture through an injector into a reactor operated at a second temperature that is below a temperature necessary to thermally crack the hydrocarbon load under the conditions within said reactor;

wherein said injector adiabatically relieves the load/jet mixture to an extent such that said load within the reactor attains sufficient mechanical energy to shear said hydrocarbon molecules in said load to produce distillable lighter liquid products.

46. **(New)** The process of claim 45 wherein the process produces substantially no gaseous hydrocarbons, coke or soot.

47. **(New)** The process of claim 45 wherein the jet of step (b) comprises steam.

48. **(New)** The process of claim 47 wherein the process produces a stable water-hydrocarbon emulsion.

49. **(New)** The process of claim 48 wherein the water-hydrocarbon emulsion is stable for periods of two or more months when the emulsion is unagitated.

50. **(New)** The process of claim 49 wherein the water-hydrocarbon emulsion is stable for more than one year when the emulsion is unagitated.

51. **(New)** The process of claim 45 wherein the jet of step (b) comprises CO_2.

52. **(New)** The process of claim 45 wherein substantially all of the hydrocarbon molecules of the load are broken into two parts.

53. **(New)** The process of claim 45 wherein the jet of step (b) comprises one or more gases selected from the group consisting of: H_2O, CO_2, CO, H_2 and N_2.

54. **(New)** The process of claim 45 wherein the injection of the load/jet mixture into the reactor of step (c) is configured such that the load/jet mixture does not have substantial contact with the walls of the reactor.